# PRESENTATION OF AURELIA AURITA AT THERMAL POWER STATION

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# PRESENTATION OF *AURELIA AURITA* AT THERMAL POWER STATION[1)]

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## INTRODUCTION

As the volume of seawater to be used for cooling purpose at thermal power plants increases in line with the growth of unit capacity of thermal power plants, the troubles caused by *Aurelia aurita* flowing into the intakes of the thermal power plants have become a serious problem. Especially, *Aurelia aurita* which appears around power plants in shoals during April to September every year, often blocks the intakes or damages the rake screens and, further, cause operational difficulties such as the load restriction, shut-down of power plants, etc.

Therefore, the Kansai Electric Power Company, Inc. has, as temporary measures, attempted improvement of the rake screens, the installations of the protection net for inflow of medusae, etc. And the investigation of the causes of the attacks through meteorologic and oceanographic research and the study of methods of prediction of inflows have been performed.

## DAMAGES FROM MEDUSAE

It was in about 1960 that the inflows of medusae to thermal power generating stations began to attract attention, and almost all domestic electric power companies have been suffering from the damages since 1965.

Figures 1 and 2 show the situation of the attacks of the medusae; medusae jostle at seawater intakes and stick to net screens to block the intakes, to reduce the intake capacity or to often damage the screens.

Of the power plants of the Company, Himeji No. 1 Power Station, Himeji No. 2 Power Station, Tanagawa Power Station and Sakaiko Power Station are those which had frequent attacks of the medusae, and eight times of load restrictions and six times of generation stops were recorded in 1967. Especially, at the Himeji No. 2 Power Station, the volume of medusae landed at its intake during the period from

1) Contributions from the Marine Biological Station of Asamushi, Aomori Ken, No. 364

Fig-I Medusae flowing fowards the intake

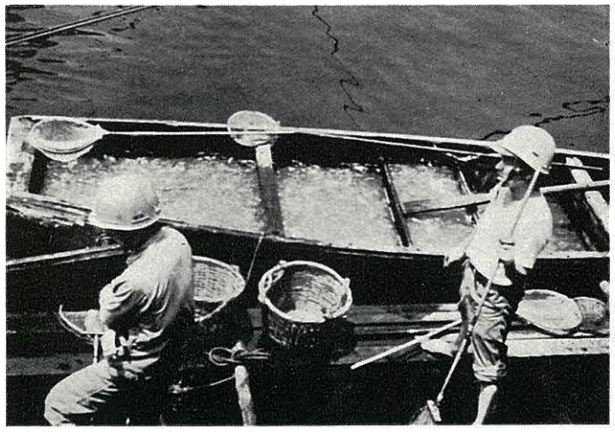

Fig-II Landed medusae

May to August amounted to about 2000 tons; the maximum volume landed in a day reached 150 tons.

*Aurelia aurita* is 15 to 25 centimeters in diameter and approaches the seashore in masses during spring a period from to the summer season. It is almost impossible to recognize them in other seasons.



During the attack seasons, shoals of *Aurelia aurita* making a width of 50–300 meters are often seen in the sea around the power stations. Such *Aurelia aurita* sinks when the wind blows and waves are high, and rises to the surface during the night or when it is calm. The medusa floats into the intake of power station with the tidal current.

## COUNTERMEASURES

At present, as countersteps for the removal and prevention, studies of the causes of the inflows were made to analyze the methods of prediction of inflow, because the informations on the physiology and mode of life are insufficient, and, at the same time, temporary measures such as installations of fish net to prevent the inflow, additions of removal screens, etc. were made.

1. At power stations which were suffering from frequent inflows of the medusae, nylon fish nets were installed, as shown in Figure III, in front of the intake at a point which would cause no direct influence on the intake current. And it was so designed that the medusae that sticked to the net are brought out by the ebb tide. However, this method was not perfect when large shoals of medusae attacked.
2. Bar screens installed at the intakes were improved, as shown in Figure IV, to increase the removal capacity by the addition of rotary rakes.
3. During the period when frequent attacks were anticipated, watch functions were strengthened by getting information from fishermen and by patroling in the sea area 2–3 kilometers from the power stations.
4. As damages caused by the attacks of the medusae were mainly from the jostling inflow of the large shoals, research of meteorological and oceanographic relations were performed to find a method of prediction.
   a) Frequency and volume of the medusa attack are related to the location of the thermal power stations. The newly installed large power stations are located by the clean ocean, not by the polluted inland sea near cities, and

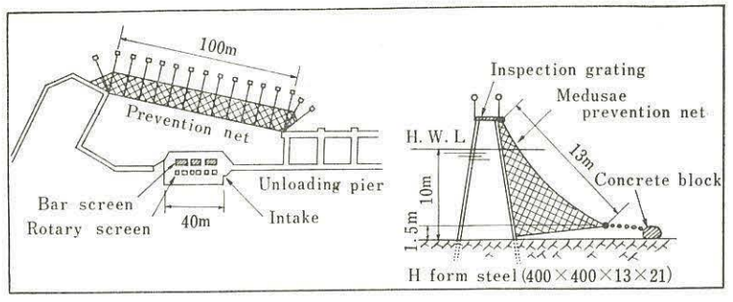


Fig-III. Medusae float preventive net

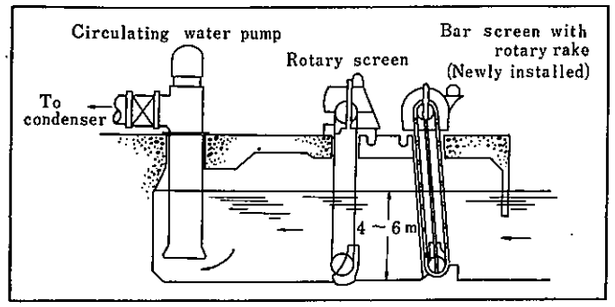


Fig-IV. Outline of bar-screen with rotary rake

require huge amount of cooling seawater. These two facts have close relation to the problem.

b) Although it had been said that the floats of the medusae would increase in a year no clear correlation was established from the observation of the monthly average weather records during the past several years. However, according to the records of velocities and directions of the wind registered at the Himeji district in July when the attacks reach the peak, it is presumed that the floating medusae were brought to the seashore by the sea wind and brought into intakes by the current around the area and the intake flow.

c) The highest tides occur during the period from June to through September when the attacks of the medusae reach their peak, and judging from the landed volumes of the medusae at the plants it is inferred that they reach the maximum at the flood tide. It can be said that the medusae move mainly with the sea current and, by being drawn by the intake current, they float into and stay around the intakes of the power stations.

d) The Himeji district which was most frequently attacked has an irregular coast line, owing to whirl pools are easily made in the sea current. The sea currents around there have a maximum velocity of about 0.55 knots in east and west directions. In addition, there is a constant flow of about 0.2 knots towards the east. It is considered that the medusae move with this constant current and accumulate along the coast line and move towards the power plants by the water flow caused by the intake current.

e) The property of sea water around the power stations which were frequently attacked by the medusae is of 17.0–18.5‰ Cl and fairly clear. However, the inflows of the medusae were often recognized even where the bay was slightly contaminated.

f) Observed from the year-round changes of planktons in the sea water, Bacillariales such as *Conscinodiscus* sp., *Skeltonema Costatum*, *Chaetoceros* sp., etc. were predominant. And, as zooplanktons reach the greatest quantities during May to July, it is considered that some relation exists between the growth of the medusae and the volume of plankton.

g) According to the investigation of mud and benthos at the bottom of the sea, it is recognized that *Aurelia aurita* floats to a district which contains higher C.O.D. and sulfur and is considered as contaminated considerably from the biological point of view.



## CONCLUSION

*Aurelia aurita* which has been recently causing troubles at the water intakes of thermal power stations did not, in the past, draw much attention because the damages then were negligible or only for a short period. However, recently, considerable damages and troubles are often caused, even to a load restriction or a power plant shut-down.

As temporary countermeasurers, installations of medusae prevention nets, improvements and additions of dust proof screens were made, and also, studies for a method of prediction of the attack have been done. However, there are many unknown points in the development and ecology of *Aurelia aurita* in the natural sea. Also, it is difficult at present to install suitable preventive facilities perfectly fitted to the mode of the shoals. In the future, study will be concentrated on the ecology of the adult medusa, such as shoal formation, etc. to find a suitable preventive method.